

CLAIMS

We claim:

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1. A conduit for providing a heated gas flow to enhance analyte ions produced by a matrix based ion source and discharged to an ionization region adjacent to a collecting capillary.

10 2. A conduit as recited in claim 1, wherein said ion source is a matrix assisted laser desorption ionization (MALDI) ion source.

3. A conduit as recited in claim 1, wherein said ion source is a fast atom bombardment (FAB) ion source.

15 4. A conduit as recited in claim 1, wherein said ion source is an atmospheric pressure matrix assisted laser desorption ionization (AP-MALDI) ion source.

20 5. A conduit as recited in claim 1, wherein said ion source is at atmospheric pressure.

6. A conduit as recited in claim 1, wherein said ion source is below atmospheric pressure.

25 7. A conduit as recited in claim 1, wherein said ion source is above atmospheric pressure.

8. A conduit as recited in claim 3, wherein said ion source is at atmospheric pressure.

30 9. A conduit as recited in claim 3, wherein said ion source is below atmospheric pressure.

10. As conduit as recited in claim 3, wherein said ion source is above atmospheric pressure.

5 11. A mass spectrometer that produces enhanced analyte ions for ease of detection, comprising:

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- (a) a matrix based ion source for producing and discharging analyte ions to an ionization region;
- (b) a collecting capillary downstream from both said matrix based ion source and said ionization region for receiving said analyte ions produced and discharged from said ion source to said ionization region;
- (c) a gas source for providing a gas;
- (d) a conduit for conducting gas from said gas source toward said ionization region and providing ion enhancement to said analyte ions located in said ionization region before said analyte ions enter said collecting capillary; and
- (e) a detector downstream from said collecting capillary for detecting said analyte ions enhanced and received by said collecting capillary.
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12. A mass spectrometer as recited in claim 11, wherein said ion source is a matrix assisted laser desorption ionization (MALDI) source.

25 13. A mass spectrometer as recited in claim 11, wherein said ion source is a fast atom bombardment (FAB) ion source.

14. A mass spectrometer as recited in claim 11, wherein said ion source is an atmospheric pressure matrix assisted laser desorption ionization (AP-MALDI).

30 15. A mass spectrometer as recited in claim 11, wherein said ion source is at atmospheric pressure.

16. A mass spectrometer as recited in claim 11, wherein said ion source is below atmospheric pressure.

5 17. A mass spectrometer as recited in claim 11, wherein said ion source is above atmospheric pressure.

18. A mass spectrometer as recited in claim 13, wherein said ion source is at atmospheric pressure.

10 19. A mass spectrometer as recited in claim 12 or 13, wherein said ion source is below atmospheric pressure.

15 20. A mass spectrometer as recited in claim 12 or 13, wherein said ion source is above atmospheric pressure.

20 21. The mass spectrometer of claim 11, wherein said conduit is selected from the group consisting of a sleeve, transport device, dispenser, nozzle, hose, pipe, port, connector, tube, coupling, container and a housing.

25 22. The mass spectrometer of claim 11, wherein said gas provided by said gas source is heated.

30 23. The mass spectrometer of claim 11, wherein said conduit encloses at least a portion of said collecting capillary.

24. The mass spectrometer of claim 23, wherein said conduit enclosing said portion of said collecting capillary defines an annular space for conducting gas flow between said collecting capillary and said conduit.

25. The mass spectrometer of claim 11, wherein said conduit is adjacent to said collecting capillary.

5 26. The mass spectrometer of claim 11, wherein said gas carried from said gas source to said ionization region is from 60-150 degrees Celsius.

27. The mass spectrometer of claim 11, wherein said gas is selected from the group consisting of nitrogen, fluorine, air, carbon dioxide, argon, xenon and helium.

10 28. The mass spectrometer of claim 11, wherein the volume of said ionization region is from 1-5 mm³.

15 29. The mass spectrometer of claim 11, wherein said gas comprises a monatomic molecule.

30 30. The mass spectrometer of claim 11, wherein said gas comprises a diatomic molecule.

35 31. The mass spectrometer of claim 11, wherein said gas comprises a triatomic molecule.

40 32. The mass spectrometer of claim 11, wherein said gas comprises a polyatomic molecule.

45 33. The mass spectrometer of claim 11, further comprising a main capillary and a coupling, said coupling for joining together said collecting capillary, said conduit, and said main capillary.

34. The mass spectrometer of claim 33, wherein said coupling further comprises a housing, a capillary cap and a spacer.

35. The mass spectrometer of claim 34, wherein said capillary cap and spacer
5 are disposed in said housing.

36. A method for producing enhanced analyte ions for ease of detection in a mass spectrometer, comprising:

- (a) heating analyte ions produced from a matrix based ion source with a directed gas to produce said enhanced analyte ions; and
(b) detecting said enhanced analyte ions.

37. The method of claim 36, further comprising collecting said enhanced analyte ions in a collecting capillary before said enhanced analyte ions are detected.

38. A method for producing enhanced analyte ions for ease of detection in a mass spectrometer, comprising:
directing a heated gas flow through a conduit to an ionization region adjacent to a collecting capillary to enhance analyte ions located in the ionization region and make said analyte ions more easily detectable by a detector.

39. An apparatus that produces enhanced analyte ions for ease of detection by a detector, comprising:

- (a) A matrix based ion source for producing analyte ions;
- (b) an ion detector downstream from said ion source for detecting enhanced analyte ions;
- (c) an ion enhancement system interposed between said matrix based ion source and said ion detector for enhancing said analyte ions; and
- (d) an ion transport system adjacent to said ion enhancement system for transporting said enhanced analyte ions from said ion enhancement system to said detector for ease of detection.

40. An apparatus as recited in claim 39, wherein said ion detector is a mass analyzer.

41. An apparatus as recited in claim 39, wherein said ion enhancement system comprises a portion of said ion transport system.

42. An apparatus as recited in claim 39, wherein said ion enhancement system encloses a portion of said ion transport system.

43. An apparatus as recited in claim 39, wherein said ion enhancement system comprises a portion of said ion source.

44. An apparatus as recited in claim 39, wherein said ion enhancement system comprises at least one conduit.

45. An apparatus as recited in claim 39, wherein said ion enhancement system comprises at least one gas source.

46. An apparatus as recited in claim 39, wherein said ion transport system comprises at least one collecting capillary.

47. A mass spectrometer that produces enhanced analyte ions for ease of detection, comprising:

- (a) A matrix based ion source for producing analyte ions;
- (b) an ion detector downstream from said ion source for detecting enhanced analyte ions;
- (c) an ion enhancement system spaced from and interposed between said matrix based ion source and said ion detector for enhancing said analyte ions; and
- (d) an ion transport system adjacent to said ion enhancement system for transporting said enhanced analyte ions from said ion enhancement system to said detector for ease of detection.

48. A mass spectrometer as recited in claim 47, wherein said ion detector comprises a mass analyzer.

49. A mass spectrometer as recited in claim 47, wherein said ion enhancement system comprises a conduit.

50. A mass spectrometer as recited in claim 47, wherein said ion enhancement system comprises a gas source.

51. A mass spectrometer as recited in claim 47, wherein said ion transport system comprises a collecting capillary.

52. A method for producing enhanced analyte ions for ease of detection by a mass spectrometer, comprising:

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- (a) producing analyte ions in a matrix based ion source and discharging said ions to an ionization region;
 - (b) enhancing said analyte ions discharged to said ionization region with an ion enhancement system; and
 - (c) detecting said enhanced analyte ions with a detector.

53. A method as recited in claim 52, wherein said analyte ions are enhanced by applying a heated gas to contact said analyte ions.

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54. A method as recited in claim 52, wherein said analyte ions are enhanced by a conduit that partially encloses a collecting capillary and provides a heated gas flow.

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